

EVALUATING ACCESS MAT PERFORMANCE

New quantitative solutions

BY RAKESH A. KHAN, PE, CWI AND MANUEL PUYANA, MSCE, MBA



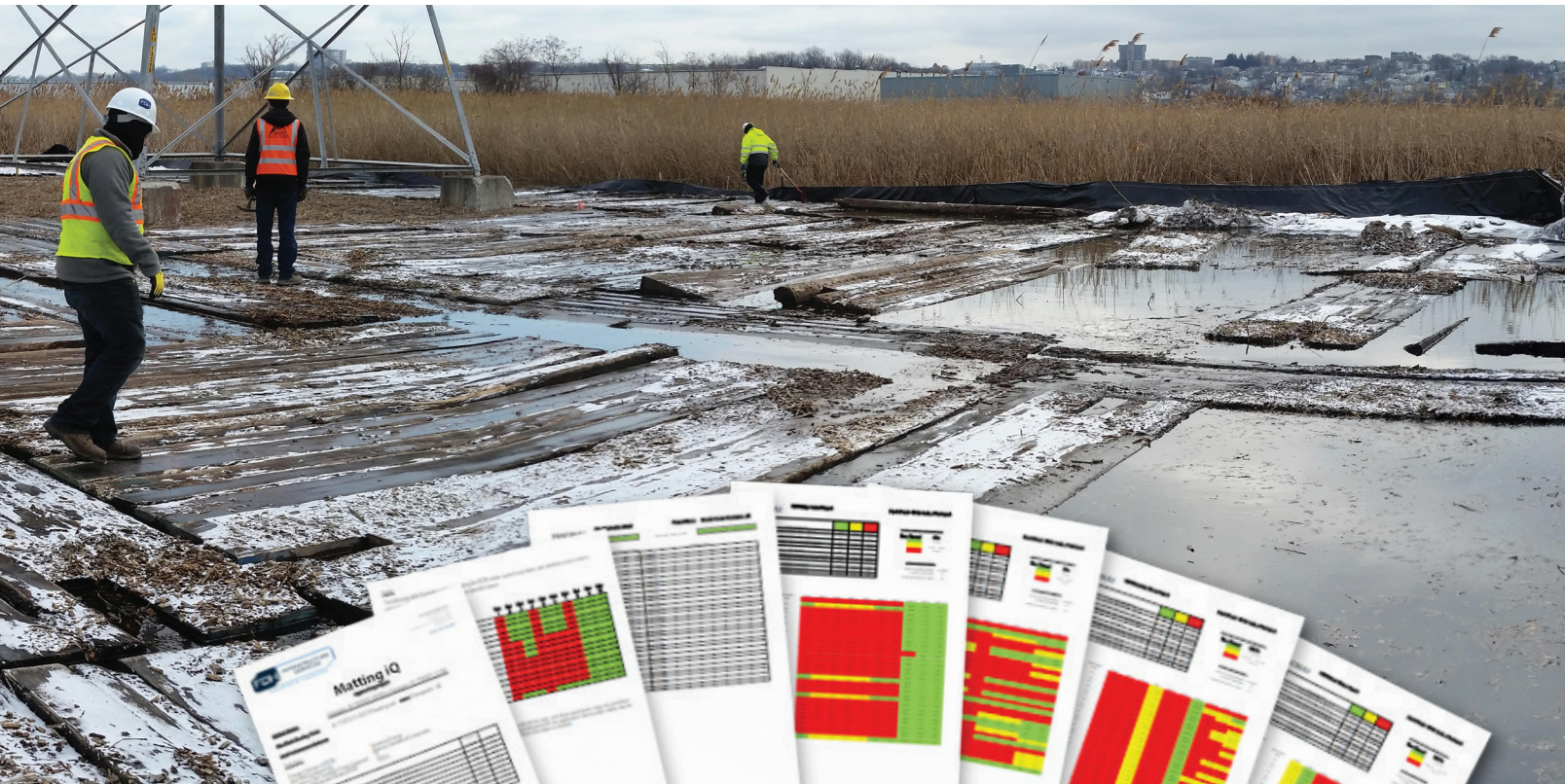
A

ccess mats are an essential, though sometimes an overlooked, component of construction, maintenance and repair activities associated with upgrading and improving critical infrastructure.

For temporary work or staging sites in remote or environmentally sensitive areas, access mats get crews and heavy equipment where they need to go to restore operations or to perform excavation, installation and erection activities. Often, these sites are accessed through easements or rights of way (ROWs).

Typically made of wood or composite materials that mimic wood, access mats are a non-trivial cost in construction operations. Matting materials usually traverse long spans of a work site, where soil conditions may change dramatically from one section to another.

For environmentally sensitive areas, such as wetlands and low-lying marshes, selecting an access mat can be a complex and potentially costly decision if not calculated properly.



Importance of Selecting the Right Access Mat

While much industry knowledge exists on various access matting products, to date, no quantitative solution has been developed to quickly specify reliable access mat solutions for a given work site.

As a result, a high potential exists for over- or under-designing an access solution or needing to change an access solution mid-project, which can lead to costly project delays including possible environmental non-compliance.

For short- to medium-sized projects, access mats can contribute \$1 to \$5 million in project costs; for larger projects, the cost can exceed \$10 million. Freight costs associated with shipping mats are a significant factor as well.

Reliable quantitative tools are needed to calculate access mat behavior for a variety of environmental conditions and access requirements.

Responding to Industry Need for a Quantitative Tool

After years of experimentation with site assessment techniques and analytical approaches, a public-private partnership developed in 2018 between Mississippi State University, FDH Infrastructure Services, and stakeholders in the matting industry. The goal of this partnership was to respond to the industry's need for a quantitative tool to calculate access mat behavior.

The result of this unique collaboration by matting industry experts is a free web calculator tool that quickly and reliably predicts the behavior of an access mat based primarily on three factors: material properties of access mat(s) of interest (drawn from both laboratory testing and a regularly updated library of mat products), the soil conditions of the site (documented from a site walk) and the anticipated load of equipment to be used on the site (based on project specifications).



Stockpiled mats

The web calculator started as and is intended to remain a free tool for the industry; however, the calculator does not replace engineering services where required.

How the Calculations Are Made

The web calculator abstracts mats as beams and uses an elastic foundation model to calculate the mats' expected performance when loaded. For soil conditions, the calculator uses the observed soil deflection under the pressure of a surveyor's foot. Converting this information, which can be collected relatively easily during a site walk survey, to the proper metrics for soil support behavior is a critical calculation performed automatically by the calculator. For the equipment load conditions, the calculator offers a set of variables that provide enough flexibility to evaluate different vehicle configurations as well as different vehicle placements on the mat. These variables include the number of load points for the vehicle, distance between them, offset from the center of the mat (in case the vehicle is working towards one side of the way), width of the tracks or tires and magnitude of load.

Equally important is the curation of the mat library, which must objectively quantify a wide variety of timber and composite parameters for the dozens of products available in a growing market. A major challenge is obtaining "apples-to-apples" parameters from product to product, as the mat assembly process, timber species selection and inherent variability in timber behavior give rise to a plethora of methods for interpretation of mat strength and stiffness. As an academic partner with deep knowledge in timber material testing, Mississippi State University plays a primary role in maintaining this library.

The calculation output includes performance over a set of five factors, which include the bending and shear stress, maximum overall and edge deflections of the mat and maximum expected bearing pressure on the soil. These results help evaluate the risk for mat rupture and soil punching, excessive deflection causing permanent rutting and the crushing of sensitive resources under the mat.

Mat Performance Calculations at Project Level

For users looking to design matting solutions for a project's access routes, which typically requires evaluating many mats over dozens, sometimes hundreds, of points and soil conditions along the route, FDH makes available Matting iQ. This solution uses the same methodology of the web calculator and evaluates in a single run the performance of up to ten mat solutions across an entire access road.



Winding temporary road

To generate an evaluation, Matting iQ uses the soil deflection observations across the entire access route collected in the site walk survey, the maximum expected load conditions and the target desired performance parameters, including the maximum desired stress on the mat solution, maximum mat deflection and maximum bearing pressure on the soil.

Matting iQ produces graphical reports that use traffic light colors to show the expected behavior of mats along each surveyed segment of the route. The detailed results are shown for each of the five performance factors that the calculator supports and summarized in a table that consolidates performance across the five factors.

The Matting iQ solution saves significant calculation time since performance of all mats and all surveyed points is done in one run. The graphical presentation of mat performance results simplifies the comparison of matting alternatives and selection of a mat, or combination of mats, and minimizes the risk of failure without overdesigning the solution.

The report also offers access route designers a better method to support matting selection. Instead of relying on intuition or basing selection solely on previous experiences at similar sites, designers can show project owners robust matting performance evaluations based on conditions expected at the site and calculations that adhere to traditional structural analysis modeling techniques.

Applications of the Tool to Date

While elements of the site assessment techniques and calculation methodology have been used since the early 2000s to successfully design and predict performance of specialty products in the matting industry, the combination of the matting calculator and Matting iQ is a relatively new offering to ROW owners and managers.

These tools encompass a substantial majority of product offerings on the market, made accessible for free online with additional services available for project-specific reports. By experimenting with the calculator, ROW owners and site managers can now better control the project risks associated with delays and change orders due to under-designing, wasted costs due to overdesign and minimize the financial and public relations consequences of avoidable environmental damage. A number of large electric utilities pioneers themselves in reducing risk through technology advances, are currently incorporating these services into their bid process.

Into the Future

Access operations for ROW projects are a difficult, imperfect, time-consuming matter. Aside from designing an efficient access solution, other obstacles remain. Managing an aging fleet of used mats, assessing the condition of both new and used mats and educating buyers on the appropriate products for different areas of criticality on their right of way are becoming hot topics. The North American Matting Association (NAMA), comprising major manufacturers, suppliers, engineers and buyers, has set its sights on driving the industry forward. Formed in late 2019, NAMA is working to standardize and educate the access industry, from linear construction to metropolitan heavy lift platforms, with a focus on safety, environment and economics.

Though often overlooked, the importance of a smart access solution is the foundation of a successful project for ROW owners and managers. ⚙️

For more information, check out the North American Matting Association (<http://www.nama-assoc.org>), FDH Infrastructure Services Matting iQ (<https://www.fdh-is.com/products>), and the matting calculator tool (<https://www.macsuu.net>).



Rakesh A. Khan, PE, CWI, is director of technology solutions for FDH Infrastructure Services, where he leads the development of innovative engineering solutions that enhance operations for clients in critical infrastructure markets, including power, telecommunications, and government. Mr. Khan is a member of the structural health monitoring, service life and nondestructive testing committees of the American Concrete Institute, the testing and evaluation committee of the Deep Foundations Institute and the technical committee of the North American Matting Association.



Manuel Puyana, MSCE, MBA, is a civil engineer and product manager for FDH Infrastructure Services. He oversees the development and implementation of software products that assess the condition of critical infrastructure, including Matting iQ and Foundations iQ. Mr. Puyana is a certified ScrumMaster and highly experienced in solutions architecture, which integrates software and hardware systems.